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Knowledge and Segregation of Municipal Solid Waste in Visakhapatnam City, India

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ABSTRACT

Improper disposal of municipal solid waste can create unsanitary conditions which in turn cause pollution, waste of resources and breeding place for vectors. Segregation, recycling and disposal of municipal solid waste may reduce pollution. The present study aims to evaluate the knowledge of people about the segregation of solid waste. As Visakhapatnam municipality has introduced dry waste and wet waste with separate dustbins in various areas of Visakhapatnam. The proper use of these dustbins, collection of waste, recycling and disposal of waste make the city clean and green. In our study different houses with different habits were identified, a survey was conducted and data was collected. Most people lack knowledge about dry and wet waste. And get confused about wet and dry waste. In this study difference between dry and wet was clearly explained and motivated people to follow for a better city.

Key words : *Dry waste, Wet waste, Visakhapatnam.*

Introduction

The waste which is released from houses as garbage from kitchen waste, construction debris, hospital waste, waste from street sweeping, sanitation residues, industrial waste, commercial refuse constitutes municipal solid waste (CPCB 2000). One of the major problems faced by municipalities is Municipal Solid Waste Management as it consists of a lot of expenditure and grabs attention towards its austerity (Bhide and Sudersan, 1983; Sharholy *et al.,* 2007). There are many factors which complex waste management (Kum *et al.,* 2005; Kumar *et al.,* 2017) by having interrelationships with each other such as legal, socioeconomic, cultural, environmental and economic facts. Many Asian countries and their cities are badly facing problems in managing their solid waste. The population growth of any developing nation is directly proportional to the waste generation (Sharholy *et al.,* 2007), urbanization and waste disposal, as more land is needed for its disposal which is very challenging. The second most populous nation in the world is India and with steadfastness urban population is rising with 2.99%. In many cities and towns of India, municipal solid waste is disposed of in open spaces or open sites which severely cause environmental hazards, as crude disposal can cause air, water and soil pollution. The urban development authority of India is very much concerned about municipal waste management (CPCB, 1999; Kumar *et al.,* 2009). The extensive use of plastics and packaging materials in urban areas is changing the pattern of composting (CPCB, 2003). The solid waste generated in India has increased from 6 million tons in 1948 to 48 million tons in 1997 and now 89 million tons in 2018 with an annual growth rate of 4% and expected to increase to 340 million tons by 2050 (CPCB, 2014).

Improper disposal of solid waste can create a menace and breeding ground for many vectors. Proper management requires the construction and installation of essential facilities and machinery based on a suitable management plan (Shimura *et al.* 2001). In many places in India, the waste is disposed of in an unorganized manner at the corners of the roadsides unhygienically. The government of India has introduced segregation of waste in terms of dry and wet waste which later used to the recycling of dry waste and manure production of wet waste. This paper mainly focuses on the knowledge of people on the segregation of waste in Visakhapatnam city and proper implementation for better disposal of solid waste.

Study Area-MSW Overview

City Visakhapatnam is a fast developing port city in India. This city is the second-largest urban agglomeration in Andhra Pradesh state. Initially, the city was a small fishing village with a natural harbor which later developed into a major port. The city has experienced rapid industrialization with an increase in industries which includes steel, petroleum refining, etc. This led to the formation of GVMC ("Greater Visakhapatnam Municipal Corporation" in 2005) which further enhanced the development of the city and taking responsibility for the management of Municipal Solid Waste of the city. The city has a population of about 2173457 inhabitants in 2019 (GVMC report). The annual growth rate of the population is 3.35% (Census, 2011) which could also increase solid waste. The city Solid Waste Management is performed by the primary collection system which includes door to door collection, transportation, and disposal by the health wing of GVMC. The collection process of waste involves MSW collecting from streets in pushcarts and dumped into dumper bins or dumper placers, then loaded into the vehicles, which transport the waste to different disposal sites. Every year GVMC spends 15% of its total budget on municipal solid waste management.

Existing collection and transportation system by GVMC

Primary Collection System: Waste is collected from door to door from different houses and then transported. Transportation of waste from secondary collection points at regular intervals is one of the essential jobs in MSW Management. Presently segregation and Door-to-Door garbage collection are being carried out but not so effectively. Waste is collected from the households and those which are recyclables are sold away by the workers and the organic waste is collected into the plastic baskets or in the trolley. Waste is also collected by pushcarts. At present 45% of households are being covered in 45 sanitary divisions. In the remaining household, recyclables are segregated through rickshaws (720 nos) and in-organic material segregated at windrows compost. Street sweeping and Drain cleaning activities were also carried out and waste is being posted in dumper bins

Secondary Waste Collection: As per GVMC collection and transportation of waste is carried out throughout the year including the public holidays (Table 1). The waste is collected and loaded to the transfer station in 4-5 trips per day and deployed at Kapuluppada region. The leftover food from star hotels and other hotels accounts for about 20 MT per day and waste from dumper bins includes 300 MT.

Table 1. Source of Municipal Solid Waste of Visakhapatnam

S.No	Sources of Waste	Percentage
1.	Domestic places	42
2.	Hotels and restaurants	26.2
3.	Market areas	10.1
4.	Street sweeping	9.2
5.	Workshops/shops	5.2
6.	Offices	4.8
7.	Hospitals	2.5
8.	Total	100

Source: GVMC

Transportation: The waste collected from houses, shops, hotels, and other commercial areas was transported from transfer station to Kapuluppada dumping site with the help of big tippers.

Treatment and Disposal of Waste: The waste that is collected from different areas are disposed of in an open area of about 80 acres of Kapuluppada disposal site. This disposal site is working for 7 years where open burning of waste is practiced. There is a compost plant that receives 5 to 6 tones of solid waste per day. The received waste was segregated and compost is prepared which will be sold to farmers in the later stages. Though the government has taken some measures to recycle solid waste, the lack of knowledge among people has made the segrega-

tion task difficult among GVMC management (Vizag, DPR 2015). The present study has taken a survey to know the people's knowledge of the major classification of segregation of waste that is dry and wet waste.

Methodology

Samples of Municipal Solid Waste were collected from different wards to determine its characteristics for one year as a primary study. Standards procedures were followed for the sampling and analysis of municipal solid waste as described by Peavy *et al.* 1985. 1025 samples were randomly collected from wards and ten samples were collected from the disposal site (Kapuluppada).

So in our second phase of the study, a questionnaire was carried out on randomly selected houses/flats in various areas in the city. The selection of questionnaire was done by taking into account of previous knowledge of Buenrostro et al 2001 using a door to door surveying to know the data about basic information about solid waste, types of solid waste, what items come under wet waste and dry waste, daily disposal of waste, availability of two dustbins (wet and dry), collection frequency, satisfaction levels, etc. Later the collected data was analyzed by using simple statistics through Microsoft Excel where average, standard deviations, and errors at 90% confidence were done.

In the final phase of the study, people were motivated and given knowledge about waste discrimination, like a wet and dry waste. Uses of segregation of waste, how it is helpful for GVMC etc.

Results and Discussion

As it was known fact that solid waste management leads to austerity. But in our study, it was noticed that knowledge on the basic step of solid waste management that is segregation was poor among the public. Though there were many programs conducted by the GVMC regarding the segregation of dry and wet waste, there was a failure in implementation by the public.

The present study of the analysis shows municipal solid waste contains 49.5% organic matter and 40 % other miscellaneous waste (concrete, wood, chips, bricks, dust, etc) materials shown in Table 3. The recyclable material percentage such as plastic, metals, glass, etc was identified to be very less compared to other waste. This might be due to the working process of rag pickers who collect and segregates recyclable material from the locality dustbin points and disposal site.

From the present study, the municipal solid waste generated per day is 1096 M.T with a per capita per kg per day is 0.49. The per capita generation rate for various areas in Visakhapatnam city is shown in Table 2. In our study, it was identified that 73 ± 4.6 % of people dispose of garbage daily from their houses in which 43 ± 2.6 % of people dispose of in dustbin containers provided by the GVMC and 56 ± 9.7 % dispose of in streets.

Fig. 1 describes people's satisfaction toward municipal solid waste collection, in which more than 40% of people are satisfied with the collection of solid waste by the municipal authority. Fig. 2 shows the collection frequency of solid waste from differ-

Table 2. The amount of Municipal Solid Waste generated in Visakhapatnam

Year	Population	Per Capita Waste generation (kg/c/day)	Waste generated from household per day @ 30% (M.T)	Commercial waste per day @ 60% (M.T)	Street sweeping per day @10% (M.T)	Total waste generation ((M.T)/day)
2014	1,878,000	0.47	531	266	89	885
2016	1,975,000	0.48	574	287	96	957
2022	2,278,000	0.50	711	355	118	1,184
2027	2,554,000	0.52	853	426	142	1,421
2032	2,854,000	0.54	979	499	162	1,640
2037	3,105,000	0.56	1029	512	172	1,713
2042	3,278,000	0.60	1067	565	189	1,821

Source: GVMC

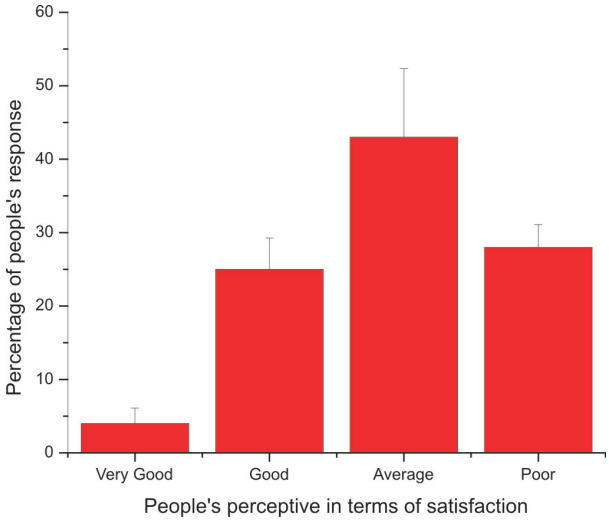

Fig. 1. People's perceptive in terms of Satisfaction

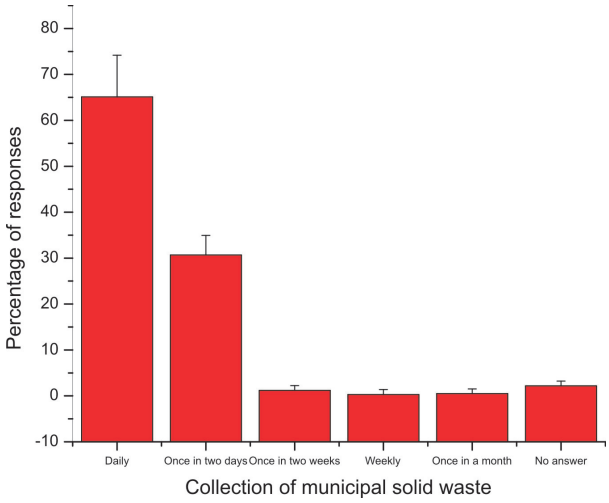

Fig. 2. Collection frequency of municipal solid waste

ent localities of Visakhapatnam city.

Further, it was noticed that 34% of people are aware of segregation waste following two different dustbins for dry and wet waste. These people also aware that single-use plastic is ban in many parts of India and they follow government rules properly. Rest 66% are not aware of the segregation of waste, they combine both biodegradable and non-biodegradable waste and through to streets or community dustbins.

We attempted to educate people about government involvement in the segregation of waste as dry and wet waste. Initially, we have segregated houses as an owner who through waste in the dustbin and maids of the house use through waste. Accordingly, we have given information about dry and wet waste to the people. Fig-3 gives information about the people's knowledge about the segregation of waste before the survey and Fig-4 gives information about the change in people's perceptive and stated segre-

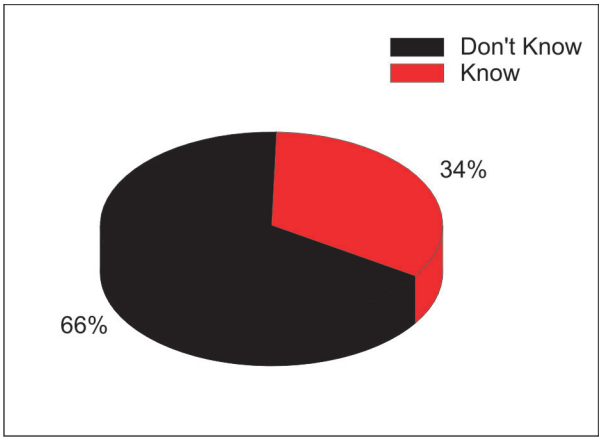

Fig. 3. People's knowledge on the segregation of municipal solid waste as dry and wet waste

Table 3. Estimation of municipal solid waste constituents in Visakhapatnam

Constituents	Percent of waste	Standard deviation	Percent error at 90% confidence
Vegetable and fruit waste	49.5	4.96	1.61
Paper	3.6	1.08	0.38
Plastic	3.01	0.98	0.26
Glass	1.0	0.97	0.39
Metal, tin can	1.2	0.71	0.25
Cardboard	1.23	0.67	0.31
Other wastes (concrete, wood, chips, bricks, dust, etc)	40.8	4.19	1.71
Total	100		

n=22

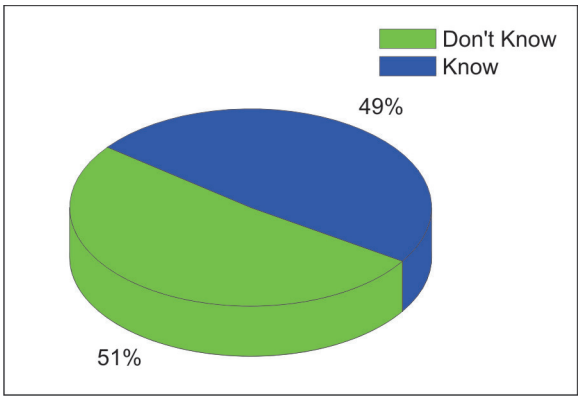

Fig. 4. The percentage of people stated segregating waste into dry and wet waste

gating waste as dry and wet waste.

The study also involved in giving information about the wet waste which is collected is converted into compost and given to the farmers for usage as organic manure in agricultural fields and also explained the benefits of organic manure and synthetic manure in the yield of the crop. This information made them involve more in the segregation of dry and wet waste.

Conclusion

The major portion of municipal solid waste is generated from houses and markets as organic waste which contributes 49.5%. So proper segregation of municipal solid waste is necessary to reduce the burden of landfills and provide raw materials for manufacturers. Composting of organic waste will act as a good source of manure and recycling and reusing of other waste reduce pollution. At present awareness among the people about the segregation of waste and proper implementation will maintain the austerity of the city. This study presented the current status of municipal solid waste management systems of the city and taken a step to motivate people about the segregation of waste for proper waste management.

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